

WHAT IS CLAIMED IS:

1. A spark plug comprising a tubular metallic shell, an insulator disposed in the metallic shell such that a distal end portion the insulator of protrudes from an end surface of the metallic shell, a center electrode disposed in the insulator such that a distal end portion of the center electrode protrudes from an end surface of the insulator, and a ground electrode which has a proximal end joined to the end surface of the metallic shell and a distal end portion which faces said distal end portion of the center electrode to thereby form a spark discharge gap,

wherein, if a side of the spark plug toward the spark discharge gap along a direction of an axis of the center electrode is defined as a front side,

a front end portion of the center electrode is formed as a circular cylindrical center-electrode noble-metal ablation resistance portion whose radius r (mm) and length l (mm) are determined so as to satisfy $5 \leq l/r^2 < 20$;

the ground electrode is an ignition-performance-improving ground electrode in which a distal end portion thereof is bent in a direction toward the center electrode; a rear end-edge of a distal end surface of said distal end portion is located frontward in relation to a front end surface of the center-electrode noble-metal ablation resistance portion; and, in an orthogonal projection on a projection plane perpendicularly intersecting said axis of the center electrode, the rear end-edge is located outward in relation to the front

end surface of the center-electrode noble-metal ablation resistance portion;
and

a portion of the ignition-performance-improving ground electrode which includes at least the rear end-edge is a ground-electrode noble-metal ablation resistance portion.

2. The spark plug as claimed in claim 1, wherein, when viewed in an orthogonal projection on a projection plane in parallel with a plane which includes said axis of the center electrode and a geometric barycenter position of a section of the ignition-performance-improving ground electrode cut at a position located 1 mm forward from the end surface of the metallic shell by a plane perpendicularly intersecting the axis of the center electrode, and: an origin on the projection plane is defined as the position of the closer of the two end edges of the distal end surface of the center electrode to the rear end-edge of the ignition-performance-improving ground electrode; an x-axis on the projection plane is defined as extending through the origin in parallel with the distal end surface of the center electrode such that a side corresponding to a position of the ignition-performance-improving ground electrode is positive in polarity; and a y-axis on the projection plane is defined as extending through the origin in parallel with the axis of the center electrode such that a side corresponding to a position of the spark discharge gap is positive in polarity,

coordinates (x, y) (unit of length: mm) of the rear end-edge of the ignition-performance-improving ground electrode are determined so as to satisfy

$$1.6 \geq y \geq 0.4;$$

$$x > 0; \text{ and}$$

$$y \geq (\tan^{-1} 16^\circ)x.$$

3. The spark plug as claimed in claim 1, wherein the ignition-performance-improving ground electrode comprises an electrode body and a noble metal element which is joined to the electrode body at a position facing the spark discharge gap and serves as the ground-electrode noble-metal ablation resistance portion; and

as viewed in an orthogonal projection on a projection plane in parallel with a plane which includes said axis of the center electrode and a geometric barycenter position of a section of the ignition-performance-improving ground electrode cut at a position located 1 mm forward from the end surface of the metallic shell by a plane perpendicularly intersecting the axis of the center electrode:

(a) only certain parts of the distal end surface of the ignition-performance-improving ground electrode, including the rear end-edge, are constituted by a distal end surface the noble metal element, and said distal end surface of the noble metal element protrudes toward the axis of said center

electrode beyond a distal end surface formed by the electrode body which constitutes the residual portion of the distal end surface of the ignition-performance-improving ground electrode; and

(b) an element surface of the noble metal element which extends from the rear end-edge toward a side corresponding to a proximal end of the ignition-performance-improving ground electrode is substantially parallel with the front end surface of the center-electrode noble-metal ablation resistance portion.

4. A spark plug comprising a center electrode, a metallic shell disposed so as to surround a circumferential side surface of the center electrode, and a ground electrode whose proximal end is joined to an end surface of the metallic shell and which forms a spark discharge gap between the metallic shell and the center electrode, wherein:

if a side of the spark plug toward the spark discharge gap along a direction of an axis of the center electrode is defined as a front side,

the ground electrode is an ignition-performance-improving ground electrode in which a distal end portion thereof is bent in a direction toward the center electrode; a rear end-edge of a distal end surface of said distal end portion is located frontward in relation to a front end surface of the center-electrode noble-metal ablation resistance portion; and, in an orthogonal projection on a projection plane perpendicularly intersecting said axis of the

center electrode, the rear end-edge is located outward in relation to the front end surface of the center-electrode noble-metal ablation resistance portion; and

as viewed in an orthogonal projection on a projection plane in parallel with a plane which includes said axis of the center electrode and a geometric barycenter position of a section of the ignition-performance-improving ground electrode cut at a position located 1 mm forward from the end surface of the metallic shell by a plane perpendicularly intersecting the axis of the center electrode, and: an origin on the projection plane is defined as the position of the closer of the two end edges of the distal end surface of the center electrode to the rear end-edge of the ignition-performance-improving ground electrode; an x-axis on the projection plane is defined as extending through the origin in parallel with the distal end surface of the center electrode such that a side corresponding to a position of the ignition-performance-improving ground electrode is positive in polarity; and a y-axis on the projection plane is defined as extending through the origin in parallel with the axis of the center electrode such that a side corresponding to a position of the spark discharge gap is positive in polarity, coordinates (x, y) (unit of length: mm) of the rear end-edge of the ignition-performance-improving ground electrode are determined so as to satisfy

$$1.6 \geq y \geq 0.4;$$

$$x > 0; \text{ and}$$

$$y \geq (\tan^{-1} 16^\circ)x.$$